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ORIGINAL ARTICLE

# Epidemiology of distal humerus fractures in the elderly



J.-L. Charissoux<sup>a,\*</sup>, G. Vergnenegre<sup>a</sup>, M. Pelissier<sup>a</sup>, T. Fabre<sup>b</sup>,  
P. Mansat<sup>c</sup>, and the SOFCOT<sup>d</sup>

<sup>a</sup> Département d'orthopédie-traumatologie, CHU Dupuytren, 2, avenue Martin-Luther-King, 87042 Limoges cedex, France

<sup>b</sup> Service d'orthopédie-traumatologie, hôpital Pellegrin, place Amélie-Raba-Léon, 33076 Bordeaux cedex, France

<sup>c</sup> Institut de l'appareil locomoteur, CHU de Toulouse, place du Dr-Baylac, 31059 Toulouse, France

<sup>d</sup> Société française de chirurgie orthopédique et traumatologie, 56, rue Boissonnade, 75014 Paris, France

Accepted: 18 August 2013

## KEYWORDS

Humeral distal fracture;  
Elderly patient;  
Osteoporosis;  
Epidemiology

## Summary

**Introduction:** Despite recent treatment advances, management of distal humerus fractures in the elderly remains one of the most challenging aspects of trauma surgery. Although these fractures are relatively rare, they fall under the umbrella of osteoporotic fractures, which themselves are increasing in frequency.

**Material and methods:** Two studies were performed: one retrospective study of 410 patients over a 10-year period and one prospective study of 87 patients over a 1.5-year period. This allowed us to analyse the epidemiology of distal humerus fractures in subjects above 64 years of age in 19 different French hospitals. All of the included patients were reviewed, except for one subject in the retrospective study who had died, but whose data was still used.

**Results:** Most of the fractures were AO type C, occurred in women in more than 80%, and occurred in nearly one of two persons above 80 years of age. Most of the patients had a high level of autonomy and lived at home. Unlike other upper limb fracture sites, nearly 90% of patients required surgical treatment. The presence of osteoporosis was found to have a tremendous impact on fracture care, complications and results.

**Conclusion:** Functional status is more important than chronological age in this patient population; the former must be taken into account when determining treatment indications.

**Level of evidence:** Level IV.

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## Introduction

Distal humerus fractures fall under the umbrella of osteoporotic fractures, as do proximal femur, proximal humerus and distal radius fractures. These are defined as fractures

\* Corresponding author. Tel.: +33 5 55 05 66 78.  
E-mail address: [jean-louis.charissoux@chu-limoges.fr](mailto:jean-louis.charissoux@chu-limoges.fr) (J.-L. Charissoux).

occurring as a result of low-energy trauma in patients above 60 years of age.

Around 30% of people 65 years or older living at home and more than 50% of those living in nursing homes or retirement homes fall every year, and about half of those who fall do so repeatedly [1]. Five percent of these falls result in fracture.

## Material and methods

### Inclusion criteria

Patients were included if they were 64 years of age or more and had an isolated, non-pathological, complex articular fracture of the distal humerus. The prospective study was conducted from June 15, 2010 to October 15, 2011, while the retrospective study was conducted from 2000 to 2010. Every patient had at least five months of follow-up.

### Recruitment rate

Slightly more patients (224, 55%) were included in the second half of the retrospective period (after 2005).

### Statistics

The study design comprised two multicentre observational studies grouping 19 French hospitals. The software STATA® (Version 11.0) was used to perform all the statistical testing. The overall results were assessed with a 0.1% significance threshold. A 5% threshold was used for testing related to the outcome measures. To take into account potential covariances in the multivariate models, variables were introduced into the initial model using a 20% threshold; variables for the final model were selected using a 5% threshold. To assess which factors were likely to affect the clinical and radiological results, multiple linear regression models and logistic regression models were performed using the Hosmer–Lemeshow test to determine goodness of fit.

### Study population

#### Retrospective study

The retrospective study included 537 patients, of which 1 subject had died but was retained because of the 82-month follow-up available before his death, and 127 were excluded (52 lost to follow-up, 31 had died with no or insufficient follow-up, 44 had key data missing). As a consequence, the 410 patients retained for the study had an average follow-up of 34 months (range 5–142.4).

#### Prospective study

The prospective study initially included 112 patients, but 25 of those were subsequently excluded (4 had died, 6 were lost to follow-up, 15 had key data missing). The 87 patients retained for the study had an average follow-up of 10 months (range 5.2 to 21.2).

**Table 1** Fractures types according to AO classification.

| Retrospective study                       | Prospective study                       |
|---|---|
| 79 A (19%)                                | 23 A (26%)                              |
| 58 B (14%)                                | 19 B (22%)                              |
| 273 C (67%) with: 85 C1,<br>79 C2, 109 C3 | 45 C (52%) with: 20 C1,<br>13 C2, 12 C3 |

### Fracture type

Fractures were classified using the AO classification system [2]; this system guides the treatment choice, evaluates the prognosis and offers the best opportunity for comparison with other published international studies (Table 1). The retrospective study had 67% type C fractures, with a fairly equal distribution between types C1, C2 and C3. The prospective study also had mostly type C fractures (52%) but not as many as in the retrospective study.

### Various treatment groups

In the retrospective study, 71% of patients were treated with internal fixation (IF) and 21% with total elbow arthroplasty (TEA) (Table 2). In the prospective study, more cases (25%) were treated conservatively (CT) than in the retrospective study. If both study cohorts are combined, 89% of the 497 patients required surgical treatment (69% internal fixation and 20% total elbow arthroplasty). This rate was much higher than the surgical treatment rate for proximal humerus fractures (21%) reported at one French trauma centre in 2012 [3]. Functional or conservative treatment was used in 11% of cases in this study, while it was used in 5% of cases in a 2007 study with the same patient population [4] and 25% of cases in a 1979 study including patients of all ages [5].

## Results

### Retrospective study (410 cases)

The average patient age was 78.4 years (range 64–100), with 41% of patients being above 80 years of age. The cohort

**Table 2** Treatments used.

| Retrospective study  | Prospective study   |
|--|---|
| 34 CT or FT (8%) with:<br>29 CT, 5 FT  | 22 CT (25%)   |
| 289 IF (71%) with: 189<br>reconstruction<br>plates, 87 locked<br>compression plates,<br>7 both, 4 EF | 53 IF (61%) with: 21<br>reconstruction plates,<br>24 locked compression<br>plates, 8 both |
| 87 TEA (21%) with: 84<br>CM, 1 Latitude, 1<br>discovery  | 12 TEA (14%) with: 6<br>CM, 5 Latitude, 1<br>discovery                                    |

CT: conservative treatment; FT: functional treatment; IF: internal fixation; EF: external fixator; TEA: total elbow arthroplasty; CM: Coonrad–Morrey.

**Table 3** Associated diseases: retrospective study.

## Associated diseases 119

|  |
|--|
| Neuropsychological disorder: 45 cases thus 11.2%     |
| Inflammatory arthritis: 23 cases thus 5.7%           |
| Elbow osteoarthritis: 21 cases thus 5.2%             |
| Long-term corticosteroid therapy: 17 cases thus 4.2% |
| Alcoholism (ongoing): 8 thus 2%                      |
| Smoking (ongoing): 5 thus 1.2%                       |

consisted mostly of women (236 patients, 82%). Women were significantly older than men (79 vs. 75 years,  $P < 0.0001$ ). The included cohort had some level of autonomy: 86% of patients living at home and 89% having a Katz score [6] above 4. The general health condition was satisfactory for most patients (72%) with an ASA score [7] of 1 or 2. A large portion of the patients (73%) had a history of osteoporotic fractures at the time of the distal humerus fracture, which was substantiated by the fact that 64% of patients had radiological signs of osteoporosis. Patients with signs of osteoporosis were significantly older (80 years vs. 75 years,  $P < 0.0001$ ). Radiological signs of osteoporosis were present in 40.5% of men and 69.2% of women, a difference that was significantly different ( $P < 0.0001$ ). A concurrent disease was found in 119 cases (Table 3); the most common was a neuropsychiatric disorder in 45 cases (11%). Sixty-six fractures were open (16%), but 95% of them were Gustilo grade [8] I or II (Table 4). Fifteen complications (3.7%) were found; all were neurological. Although three different nerves were involved, in most cases the ulnar nerve showed signs of sensory or motor-sensory deficits. Hospitalization (9.8 days average duration) was needed in 406 patients (99% of cohort), which was clearly higher than in cases of proximal humerus fracture in the 2012 Roux study (43%) [3].

### Prospective study (87 cases)

Epidemiological data for the prospective series were relatively comparable to those of the retrospective series. Again, females were more likely to fracture (84%) and the average age was 79 years. But 48% of the cohort was above 80 years of age, indicating a general ageing in the population. The ASA score was 3 or higher in 39% of cases. However, autonomy appeared identical with similar percentages found for the living situation (86% at home) and Katz score (above 4 in 89% of cases). Although only 32% patients stated having a history of osteoporotic fractures, 54% of patients ( $n = 47$ ) had radiological evidence of osteoporosis. These patients were significantly older (82 years

**Table 4** Preoperative complications: retrospective study.

|  |
|--|
| Cutaneous opening: 66 thus 16%, with 95% classified as Gustilo 1 (68%) or 2 (27%)  |
| Neurological complications: 15 thus 3.7% with: UN affected in 9 cases (4 S, 5 SM), RN affected in 6 cases (4 M, 2 SM), sensory branch of median nerve affected in 1 case |

UN: ulnar nerve; RN: radial nerve; S: sensory; M: motor; SM: sensory-motor.

versus 76 years,  $P = 0.001$ ). Dual energy X-ray absorptiometry (DEXA) scanning found osteoporosis in 38 of the 70 patients assessed (54%). Since these two modalities revealed a similar prevalence, plain X-rays appear reliable enough to detect osteoporosis. Ninety-five percent of patients were hospitalized. The average hospital stay was 10.4 days (all fracture types), which was slightly higher than in the retrospective study (9.8 days), possibly because patients were slightly older in the prospective study.

## Role of various factors on fracture care, complications and overall results

### Retrospective study

#### Fracture care

The following variables were significant at the 0.1% level. Patients receiving CT ( $n = 85$ ) were older than the ones receiving IF ( $n = 77$ ) or TEA ( $n = 79$ ). There were more closed fractures in types A and B fractures than in type C (95% vs. 78%). The Katz score was higher in patients with more complex fractures: 78% of type A and 90% type C had score above 4. The Katz score was higher during IF than CT, however the Katz score was not recorded in 31% of cases. The living situation, ASA stage, history and type of fracture had no effect on fracture care.

#### Complications

None of the factors evaluated (age, living situation, ASA, Katz score, fracture type, etc.) had a statistically significant effect on the occurrence of postoperative complications when using the 0.1% threshold.

### Overall results

The only factor having an effect at the 5% threshold level was the radiological finding of osteoporosis. When osteoporosis was present, the clinical and radiological results were worse. For type B fractures, persons living at home and younger persons had better clinical and radiological results. For type C fractures, open fractures had better results. This could be explained by the fact that most of these open type C fractures were Gustilo Grade 1 and 2 (95%), thus were treated more quickly. The ASA classification did not have a significant effect at the 5% threshold level ( $P = 0.094$ ).

### Prospective study

#### Fracture care

The following variables were significant at the 0.1% level. Type A fractures were treated conservatively more often than type C fractures (44% vs. 18%). Patients treated conservatively were older than patients treated surgically by internal fixation (85 years vs. 77 years).

#### Complications

None of the factors evaluated had a statistically significant effect on the occurrence of postoperative complications when using the 0.1% threshold.

## Overall results

The only factor having an effect at the 5% threshold level was the radiological finding of osteoporosis.

## Discussion

Distal humerus fractures account for 1–2% of all fractures in adults [9], but the incidence varies between countries. In 2003, the incidence was 6/100,000 per year in the United Kingdom [10]. It was 11/100,000 between 50–69 years of age and 20/100,000 after 70 years of age in an American study performed from 1965 to 1974 [11]. The incidence was 0.5% (5.8/100,000) in 2000 at an Edinburgh (UK) trauma unit, with nearly three-quarters of the fractures occurring in women [12]. The fracture distribution curve showed a unimodal distribution in older women that corresponded to osteoporotic fractures. In Finland, the incidence of distal humerus fractures after 60 years of age increased between 1970 and 1990 from 12 to 34/100,000 residents. It went down to 25/100,000 residents between 1990 and 2007 in all age brackets above 60 years of age [13]. However, the study authors believe the incidence will continue to increase until 2030, despite the inflection point in the curve. In Canada, the overall incidence was 7.7/100,000 residents between 2002 and 2005, but was 14 times higher in people above 80 years of age (54/100,000) than those between 18 and 29 years of age (4/100,000) [14]. Most of these were type A fractures (especially A2 and A3), which was a very different finding than in the two current studies. In the United States, a recent study [15] found two peaks in the occurrence: one in children and a second smaller one after 65 years of age, but gradually increasing up to 95 years of age, from 21 to 47/100,000. In a French study with patients above 80 years of age [16], only 1.5% of the fractures followed prospectively occurred in the distal humerus. Generally, distal humerus fractures in the elderly (above 65 years of age) tend to increase with age because an increased lifespan and more active lifestyle, which leads to more injuries, although nearly 90% of them are due to low-energy trauma. Two factors that are likely to increase the number of distal humerus fractures are the lack of care and relative lack of osteoporosis monitoring. Although these fractures are not as life threatening as proximal femur fractures, they can result in functional deterioration and eventually disability [14].

Although we do not want to bring up treatment indications, total elbow arthroplasty often provides the best early results among the currently available treatment options. However because of the magnitude of the loads placed on the elbow and the low bone quality in these patients, TEA requires limitations be placed on activities to avoid mechanical failure [17]. Thus the primary emphasis should be on determining the patient's functional status. In most published studies, indications are made based on patient age. But chronological age seems to be an unsatisfactory indicator, despite sequences such as the 3rd stage of life (60 to 75 years old) and the 4th stage of life (beyond 75 years of age, or even 80 or 85 in some cases) being introduced. Public perception is that persons in the 4th stage of life are sick, thus dependent and requiring care. But this is not accurate because 50% of those above 80 years of age are still living independently according to one published study

[18]. Thus the 3rd and 4th stage of life are not two very different time periods. Functional status or socio-functional age is more important to consider than the chronological age [18]. Other than living situation, history, ASA score and Katz score, greater value has to be placed on activities of daily living (ADL) indicators used by gerontologists, in particular physical ADL that are a reliable criteria for measuring a patient's functional status. If one does not want to use a formal scoring system (Fried criteria, SF 12, SF 36, Nottingham Health Profile, Euro-Qol, etc.), careful patient questioning can provide information as to the quality of physical ADL. The patient's activity level can be explored by talking about gardening, mowing the lawn, trimming hedges, playing golf, tennis, cycling, dancing, etc. The frequency and duration of these activities every week must be determined.

This would allow us to define different groups of patients:

- patients with good functional status who are independent, in good general health, with significant physical activity;
- fragile patients with minor ageing-related deficits (problems walking, hearing, seeing, sometimes living alone) that could lead to loss of autonomy;
- patients who depend on a caregiver, with major comorbidities and low functional demands.

This status appears to be an essential element when choosing a treatment indication, and must be considered alongside with the presence of fracture comminution.

## Conclusion

Despite recent treatment advances, management of distal humerus fractures in the elderly remains one of the most challenging aspects of trauma surgery. Although these fractures are relatively rare, they fall under the umbrella of osteoporotic fractures, which themselves are increasing in frequency. Most of the fractures were AO type C, occurred in women in more than 80%, and occurred in nearly one of two persons above 80 years of age. Most of the patients had a high level of autonomy and lived at home. Unlike other upper limb fracture sites, nearly 90% of patients required surgical treatment. Osteoporosis seems to be the determining prognostic factor. However, a patient's functional status, more than his/her chronological age, must be taken into account when deciding on treatment.

## Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

## Acknowledgements

The authors wish to thank all the symposium participants who contributed to this study: L. Hubert, F. Mallard and N. Bigorre (Angers), A. Gabrion (Amiens), L. Obert and M. Ferrier (Besançon), T. Fabre and H. Demez (Bordeaux), C. Hulet, B. Lebel and F. Dordain (Caen), D. Saragaglia and M. Milaire (Grenoble), J. Tonetti, A. Djahangiri and A. Cikes (Lausanne), L. Pidhorz, P. Alligand and E. De Keating

(Le Mans), J.-L. Charissoux and M. Benassayag (Limoges), G. Herzberg (Lyon), B. Coulet (Montpellier), F. Sirveaux and A. Jacquot (Nancy), A. Galey and B. Augereau (HEGP-Paris), S. Levante, N. Mebtouche and T. Begué (Paris), F. Duparc (Rouen), P. Clavert and G. Ducrot (Strasbourg), P. Mansat and H. Nouaille Degorce (Toulouse), L. Favard and J. Brunet (Tours).

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